A STABILIZED FINITE ELEMENT METHOD FOR STATIONARY FLOW PROBLEMS USING AN ITERATIVE DOMAIN DECOMPOSITION METHOD

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An iterative domain decomposition method is applied to finite element approximations of stationary Navier-Stokes equations. BiCGSTAB method is used as the iterative solver of the reduced linear system in each step of the Newton iteration. Also, as in [1], a stabilized finite element method is used in each step of the nonlinear iteration.

There often encounter requirements to compute what flow pattern is generated in the stationary state. With progress of computer environment and increasing demand of precise analyses, numbers of degrees of freedom of such a computation become larger. However, as far as we know, computational codes may be rare, which are efficient for large scale, stationary, and nonlinear flow problems. On the other hand, there often encounter requirements to compute convection dominated flows. When the finite element method is used, the stabilization technique is often introduced for such a computation; in case of the nonstationary Navier-Stokes equations, for example, see Hansbo and Szepessy (1990), Hughes and Brooks (1982), Tabata and Suzuki (2000), and Tezduyar et al. (1991); in case of the stationary Navier-Stokes equations, for example, see Brooks and Hughes (1982), Franca and Frey (1992) and Zhou and Feng (1993). However, as far as we know, it may be not enough to investigate what stabilization techniques are efficient for large scale, stationary, and nonlinear flow problems. From those facts, as a preliminary step of analysis of the nonlinear flow in the stationary state, we studied finite element methods with stabilization techniques for the stationary Navier-Stokes equations in [1]. Moreover, it is well-known that, thanks to the stabilization techniques, finite element approximations do not necessarily require the inf-sup condition.

In this paper, we extend this approach to an iterative domain decomposition method. BiCGSTAB method is used as the iterative solver of the reduced linear system in each step of the Newton iteration. Numerical results show that the stationary flow pattern has well agreed with that of the conventional finite element method. We will show other results and details in the symposium.

References

[1] H. Kanayama, D. Tagami, T. Araki and H. Kume, "A Stabilization Technique for Stationary Flow Problems," *Pre-Conference Proceedings of Sixth Japan-US International Symposium on Flow Simulation and Modeling*, p. 39-42, 2002.